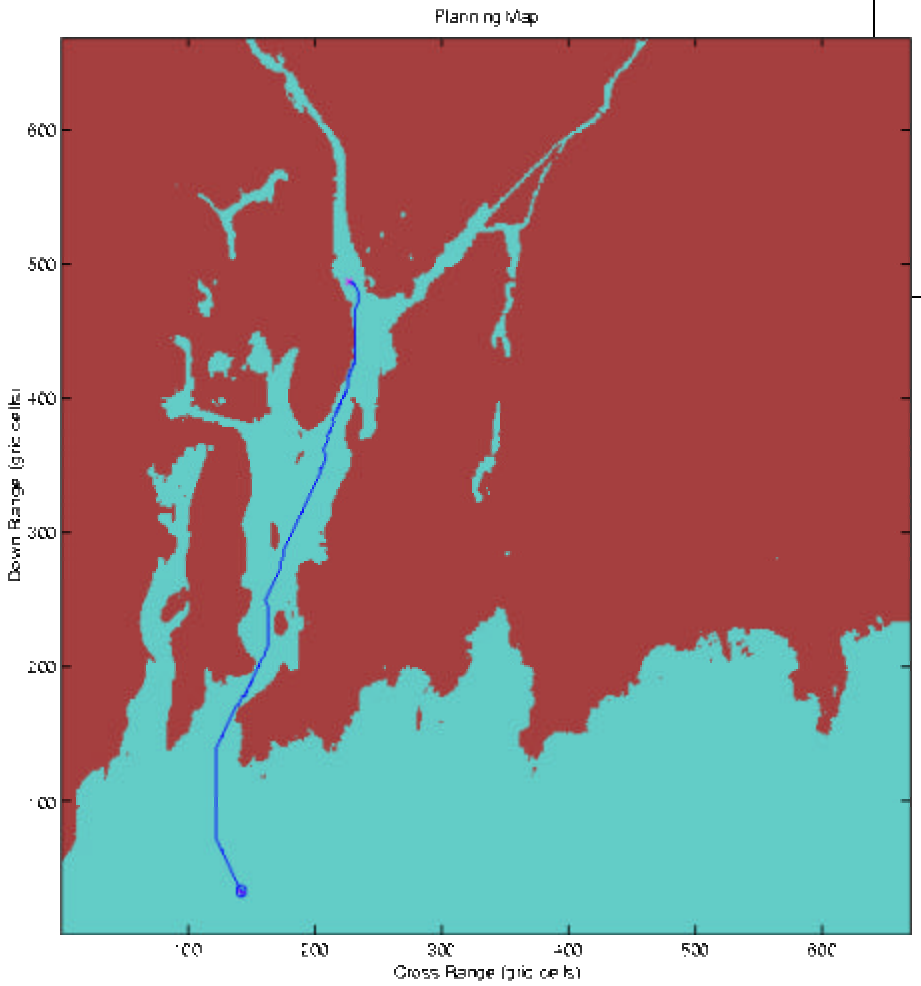
Time Critical Planning
Dynamic Replanning

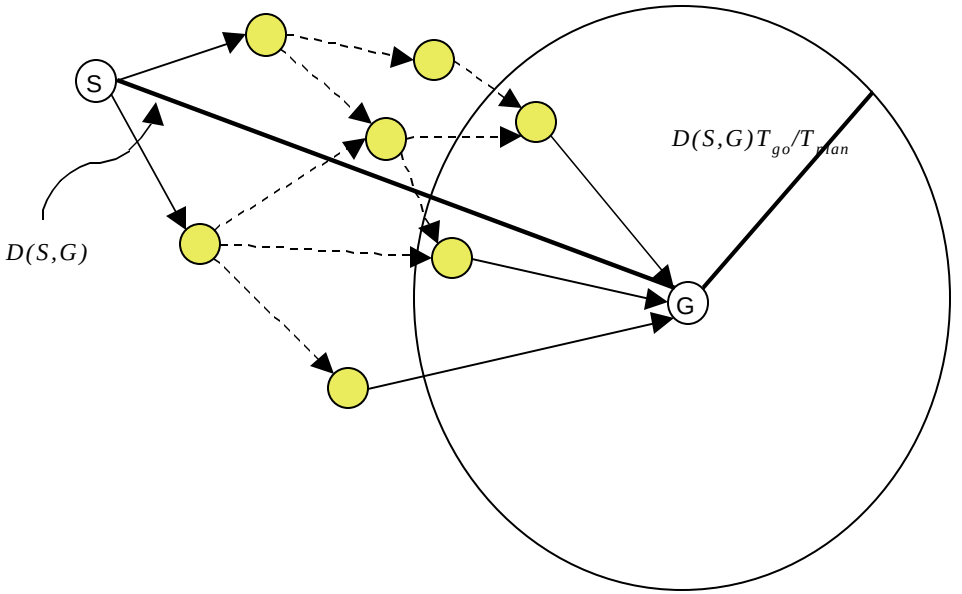
Narragansett Bay Path Planning

Forward Looking Sonar Determines Obstacles

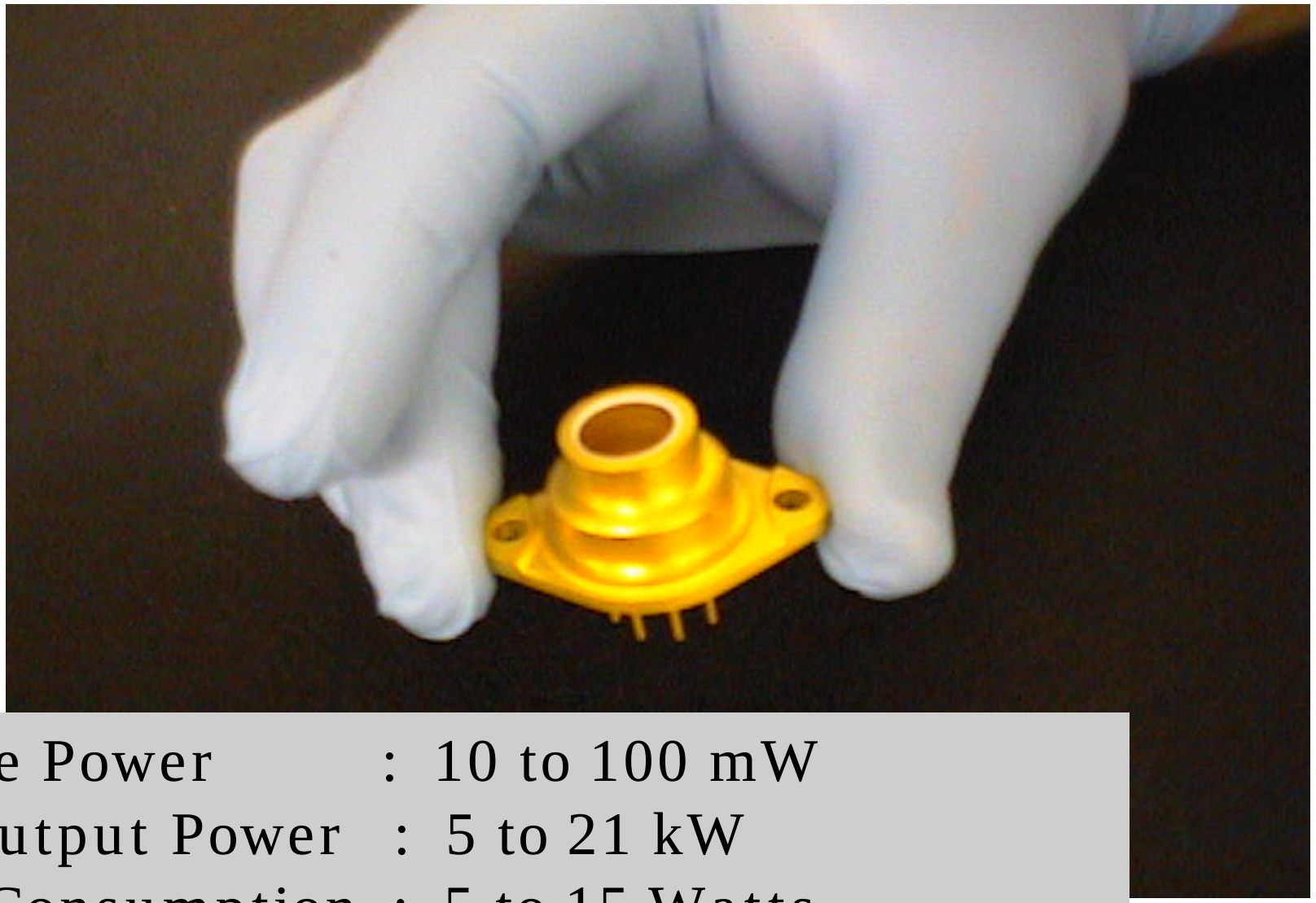
D* employed for a-priori planning & replanning



- **Shortest path algorithms derived from Dijkstra's Algorithm**
  - T* constrains time to plan
  - D* allows path planning in a dynamic environment (e.g., flying through tree canopy)
  - Hybrid D*/T* needed for Under Canopy



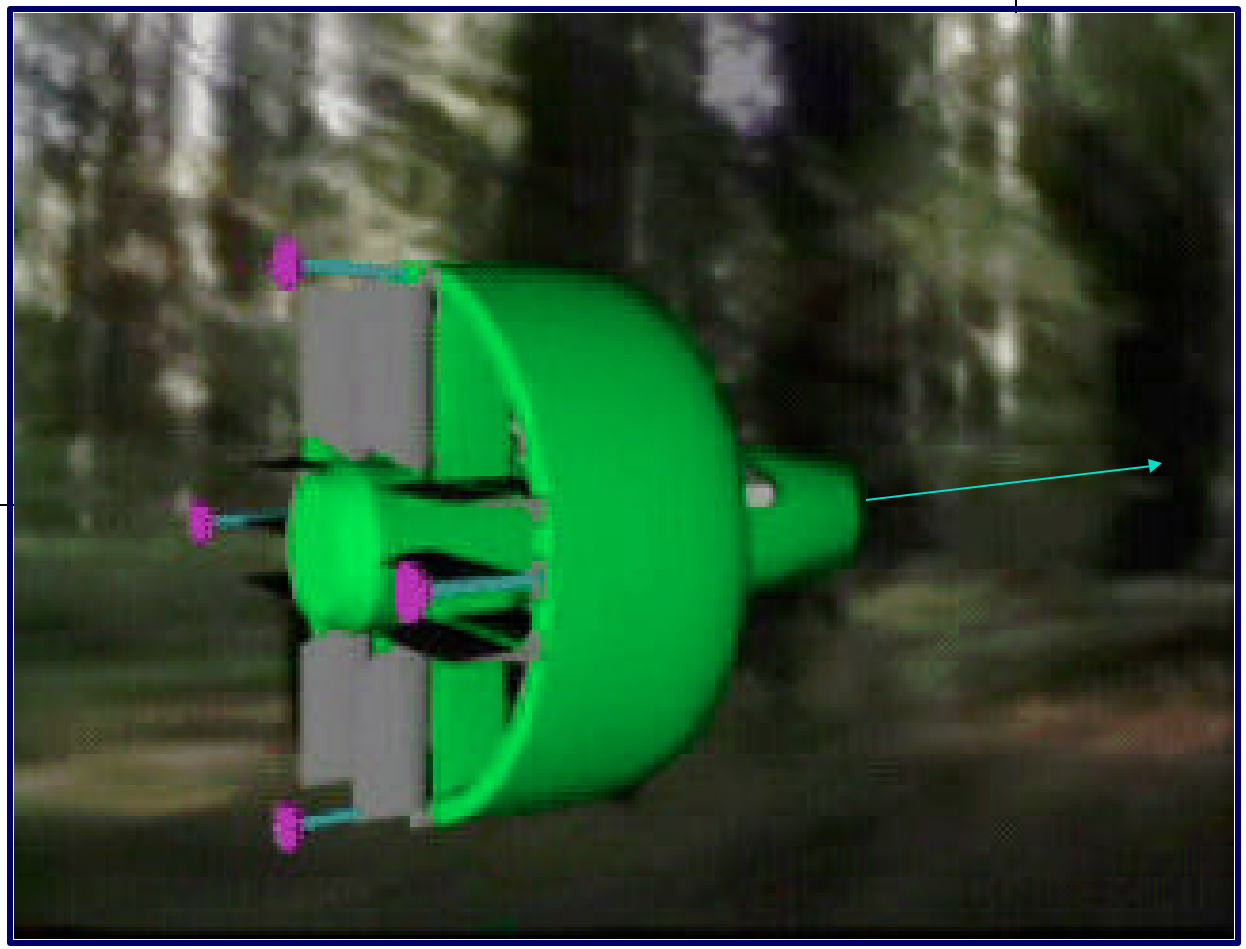
Litton's *Microchip Lasers*



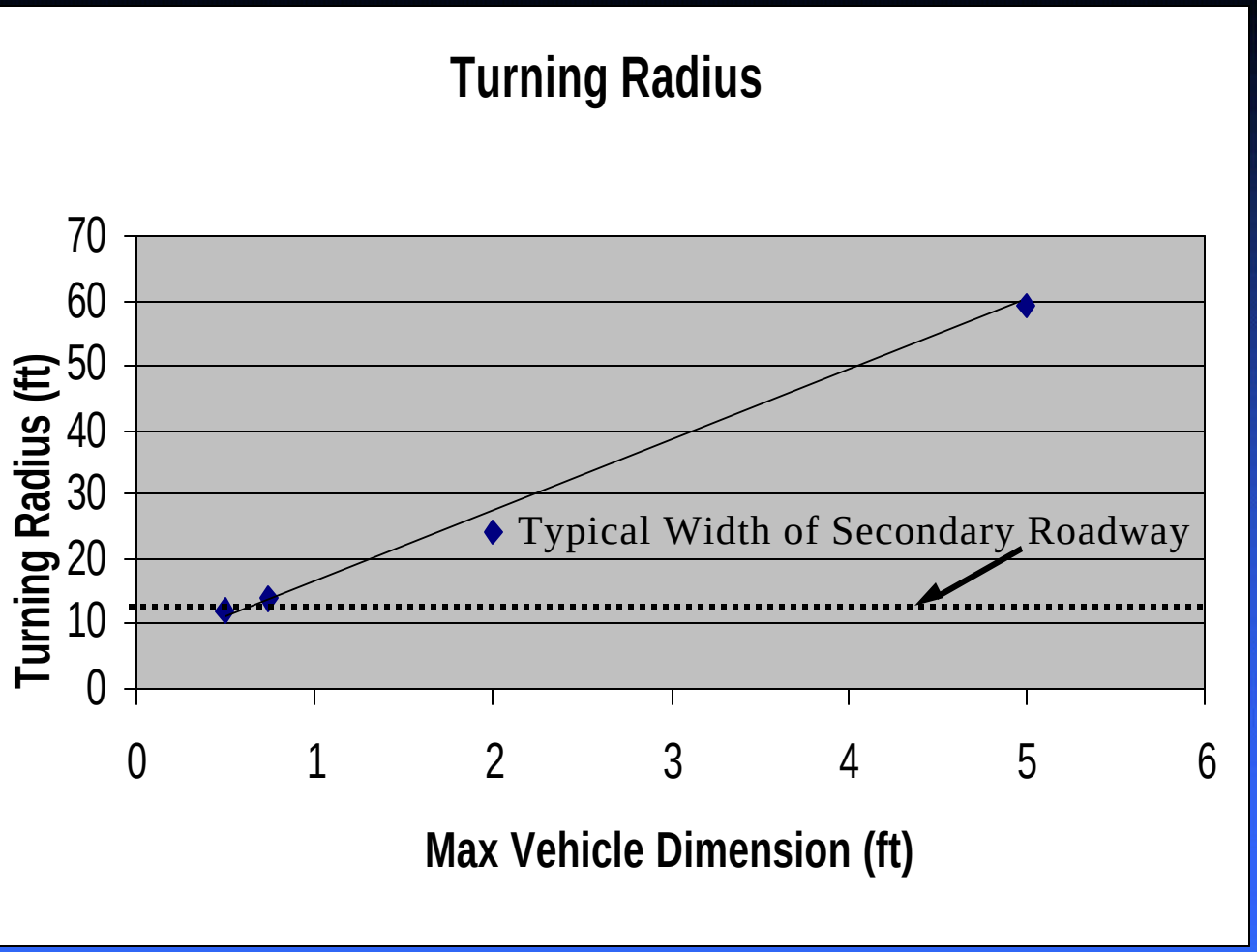
- Average Power : 10 to 100 mW
- Peak Output Power : 5 to 21 kW
- Power Consumption : 5 to 15 Watts
- Power Consumption : Typical/Max.- 4/9 Watts

LIDAR Navigation Sensor

- **Miniature LIDAR using modulated CW or pulse laser**
  - Based on currently available diode lasers and APD detectors
  - Ranging to ~50 m
- **Miniaturized packaging :**
  - ~9 mm aperture
  - ~15 g
  - <1 W

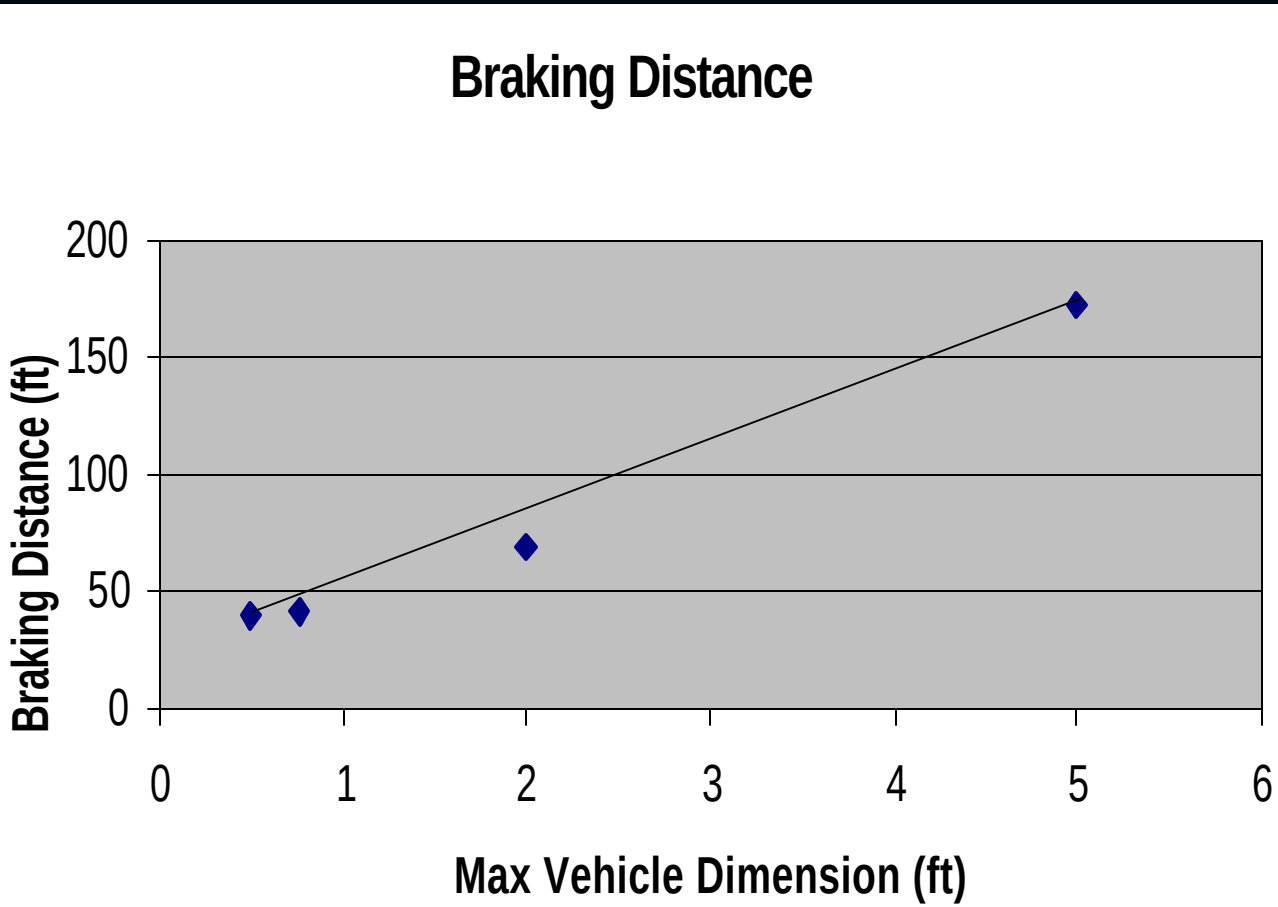


Turning Radius



- Includes The Following:
  - Control Lag
  - Thrust Reorientation Lag
  - 20 ft / sec Velocity

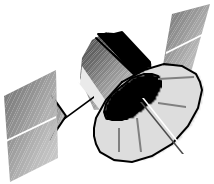
Braking Distance (aka Sensor Reqmt)



- Includes The Following:
  - Navigation / Sensor Lag
  - Guidance Lag
  - Control Lag
  - Thrust Reorientation Lag
  - Stopping Lag

Future Combat Systems
Network Centric Force

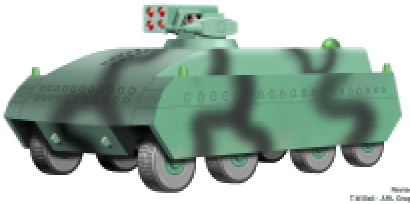
Small Unit
UAV



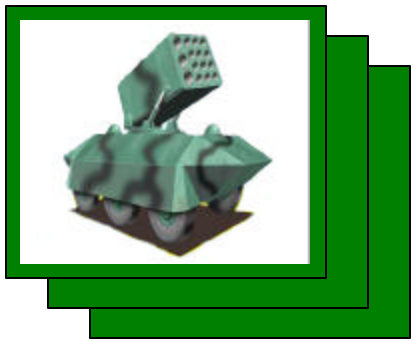
Other
Layered
Sensors

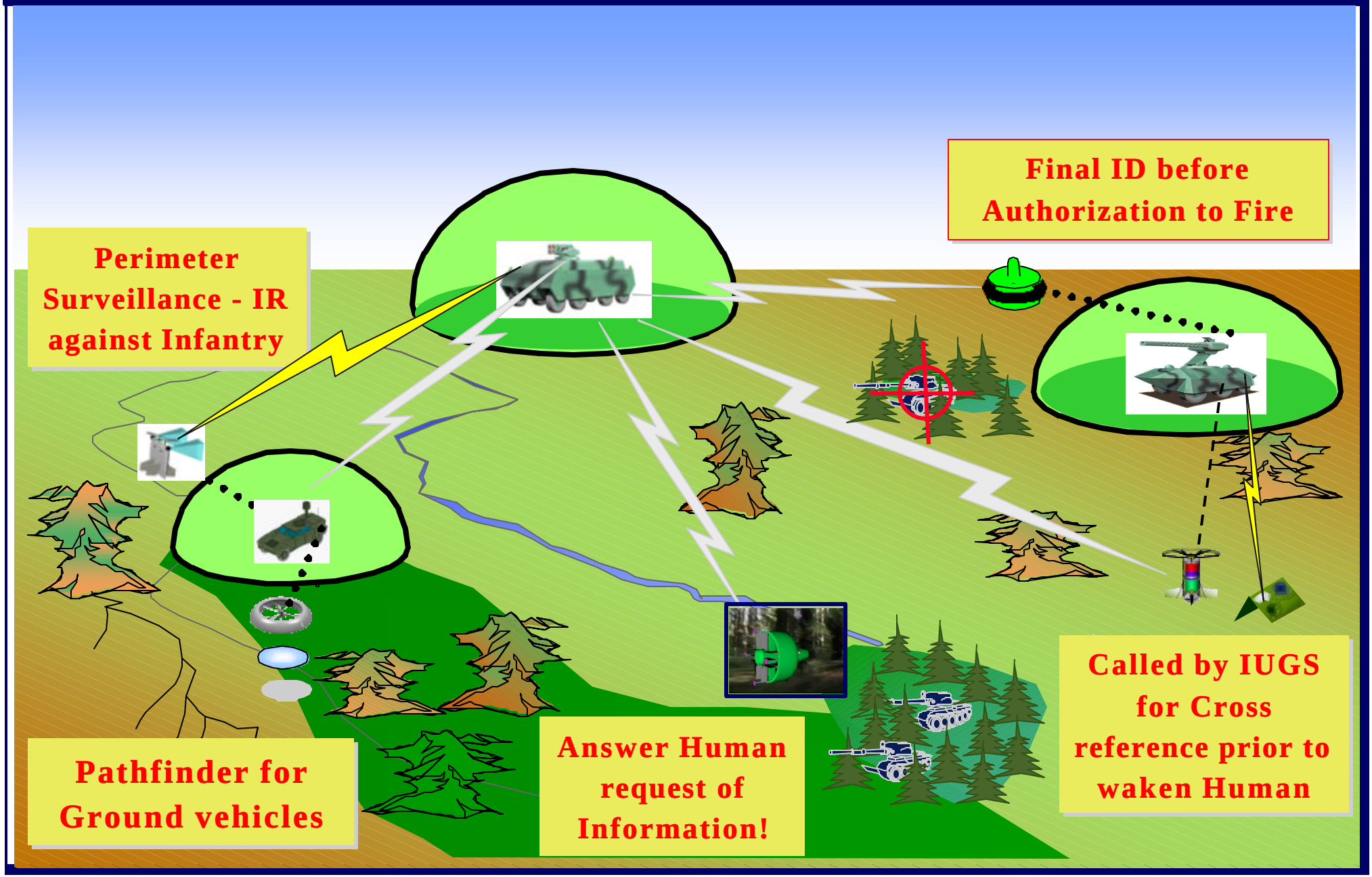
Robotic Sensor

Robotic Direct Fire



Manned C2/Infantry Squad



Robotic NLOS Fire

MAVs on the Battlefield